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Spin density and local equilibrium Wigner function for spin-half particles

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Analyzing the connections between the spin density matrix and the Wigner function for spin-half particles, we propose a new form of the local equilibrium Wigner function that solves the long-standing problem related to normalization of mean spin polarization. Interestingly, this new proposal for the local equilibrium Wigner function coincides with the recently developed generalized thermodynamic relations for perfect spin hydrodynamics using classical spin. The expressions of the conserved currents of the theory, obtained from the new Wigner function and the classical spin, match up to the second order in the spin polarization tensor. However, as expected, the two approaches fail to coincide at large values of the mean polarization.

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